Life Cycle Analysis

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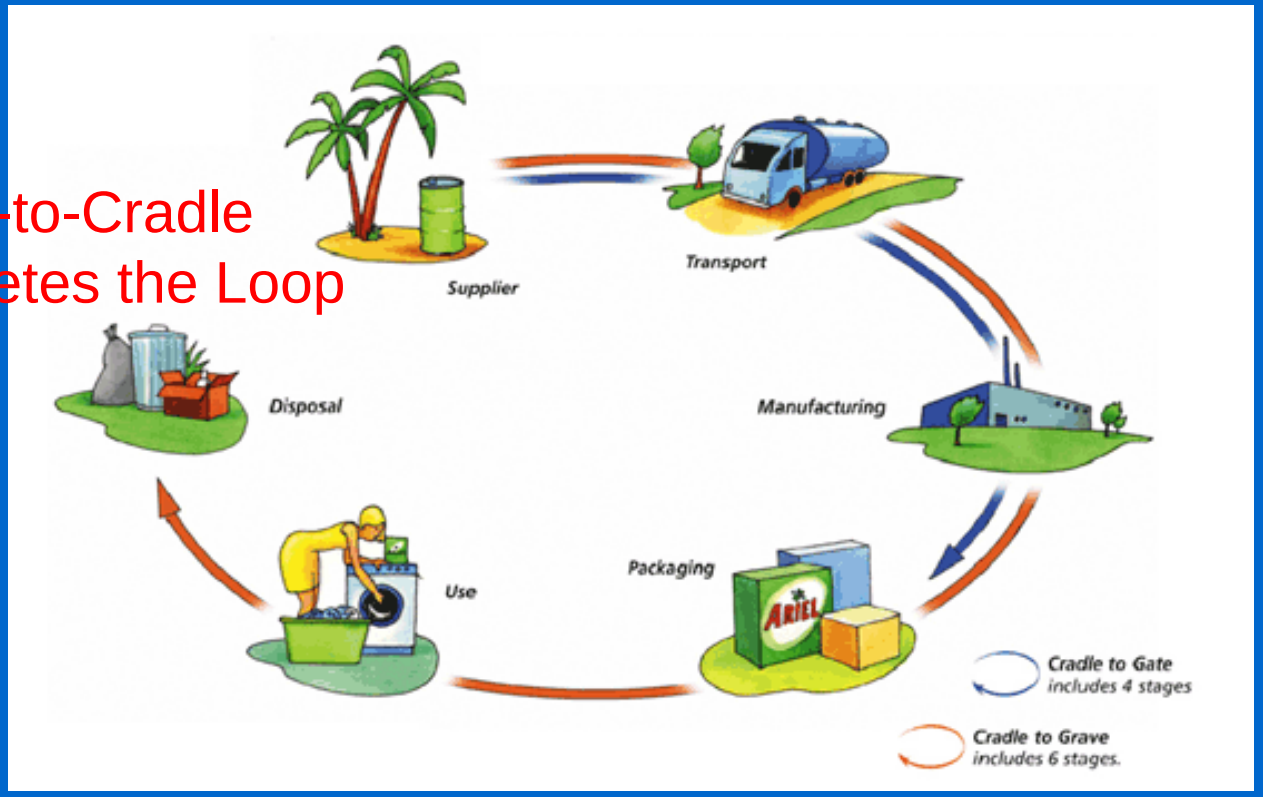
What is Life Cycle Analysis (LCA)?

- A way of looking at the effect on the environment of products (or processes) including packaging
- Considers the whole life cycle, from raw material production to ultimate fate

LCA Model

Cradle-to-Cradle
Completes the Loop

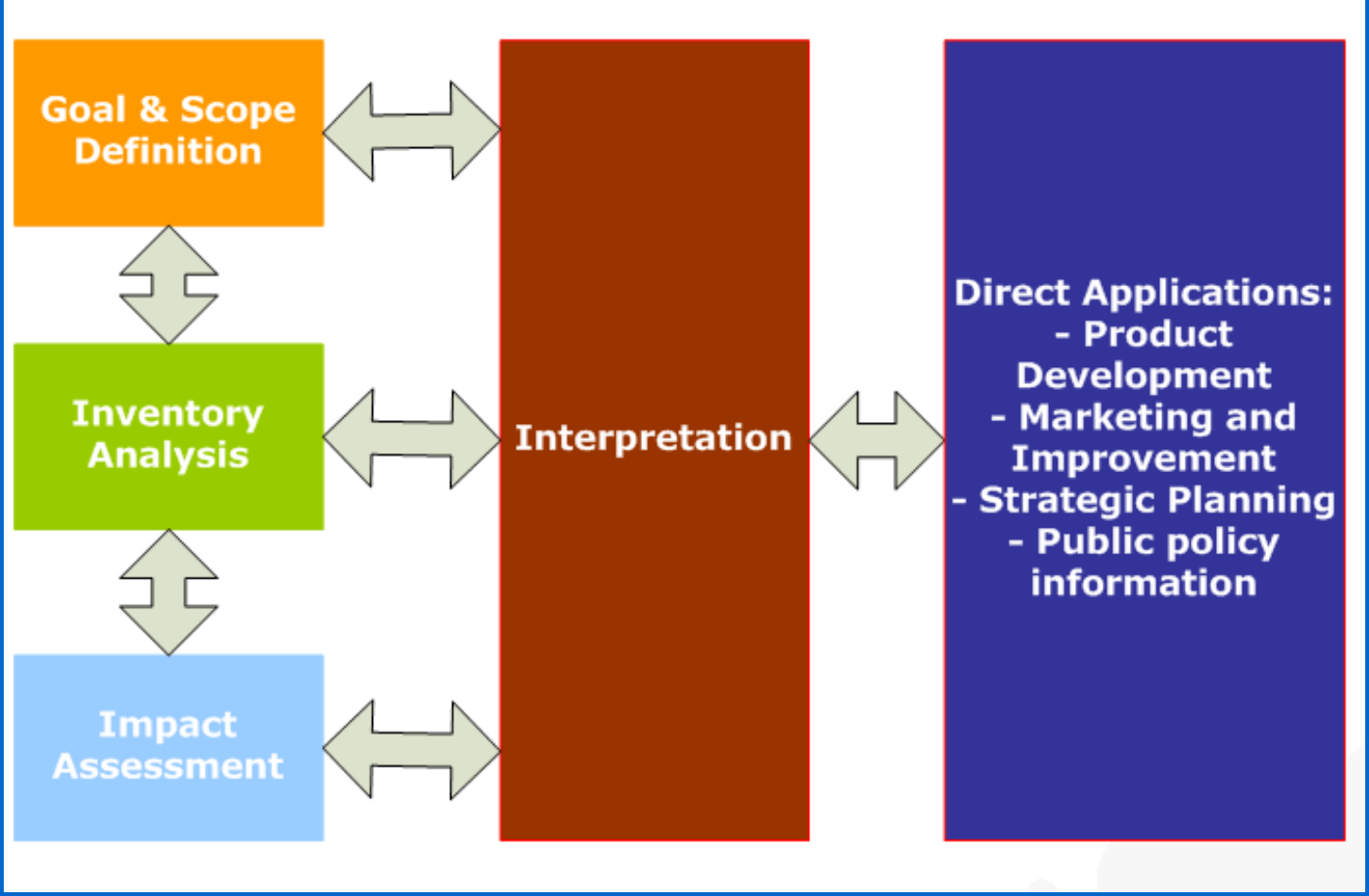


http://www.scienceinthebox.com/en_UK/programs/compactdetergents_en.html

Why Use LCA?

- Complete systems approach
  - Changes in one aspect of a product or package can have a cascading effect
    - Example: Changing the retail package may result in changes in the filling speed, the strength of the shipping cases, the weight of material being shipped, the store display options, etc.
  - If you base decisions on effects in only one part of the life cycle, you may do more harm than good

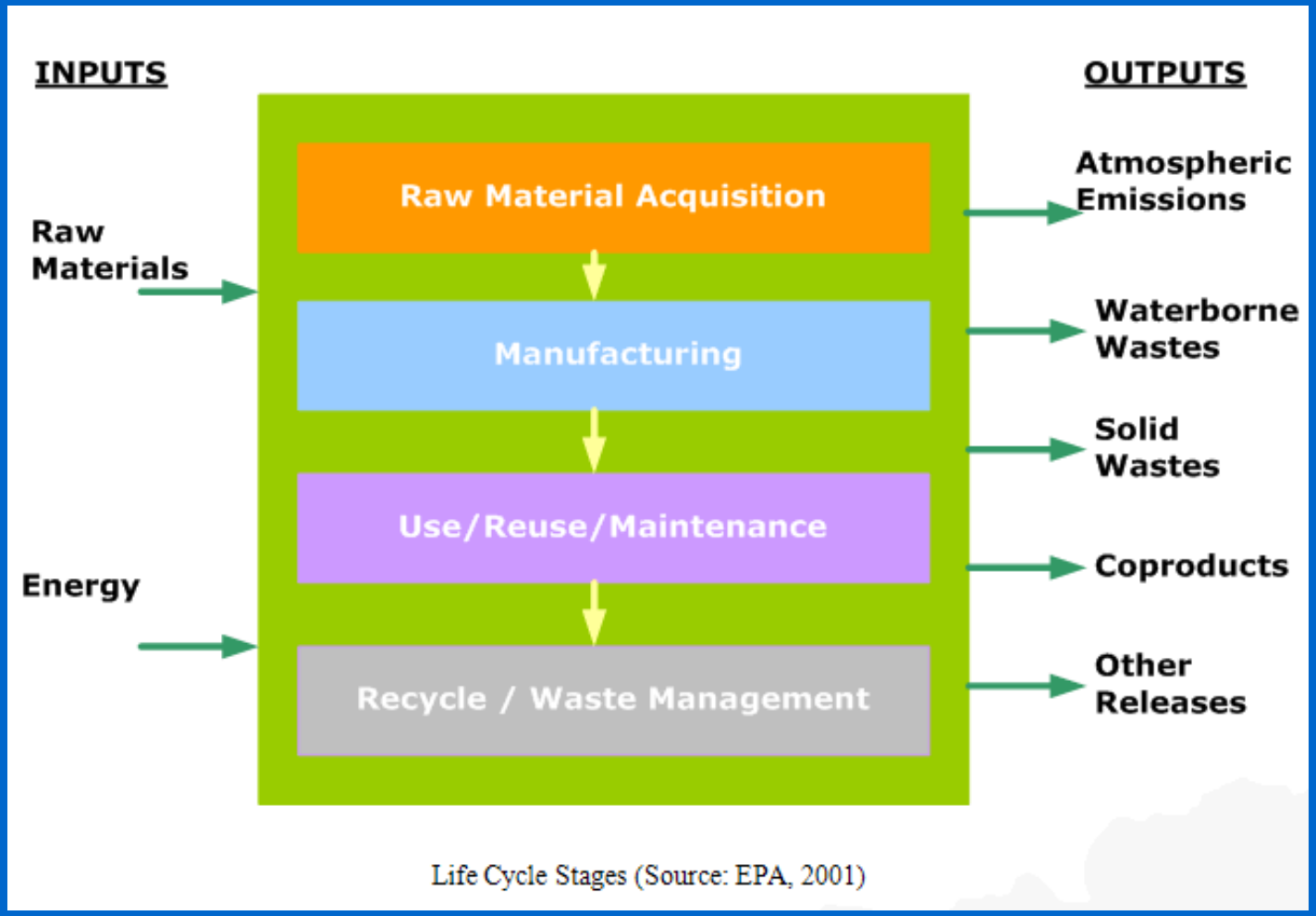
Life cycle components



Goal and Scope Definition

- What are we trying to accomplish?
  - Internal company decisions
  - Public policy
  - Other
- What is to be included and excluded?
  - We cannot include everything

Inventory Analysis



Life Cycle Stages (Source: EPA, 2001)

Impact Analysis

- "What does it mean?"
  - Takes the information from the Inventory Analysis and draws conclusions about environmental impact
  - Two main approaches
    - Single score
    - Small set of scores

Examples of Common Impact Categories

- Greenhouse gas emissions
- Air emissions
  - Carcinogens
  - Non-carcinogens
  - Respiratory inorganics
- Aquatic
  - Acidification
  - Eutrophication
- Land use
- Ecotoxicity
  - Aquatic
  - Terrestrial
- Ozone layer depletion
- Ionizing radiation
- Non-renewable energy
- Mineral extraction

Taken from IMPACT 2002, SimaPro

Issues in using LCA

- Complex
- Expensive
- Can be hard to interpret
  - Huge amounts of information
  - Trade-offs between different effects
    - Values can differ by place and time

And - LCA results depend on:

- Boundaries drawn
- Assumptions
- Data used
- Impact categories
- Weighting
- Values
  - Etc.

Need for standards

- Help ensure quality
  - Accurate data
  - Clear and appropriate procedures and assumptions
- Continuously improve methodology

Examples: ISO Standards

ISO 14040	**LCA Principles and Framework**	This standard outlines the general principles and requirements for conducting and reporting an LCA study
ISO 14041	**Environmental Management – LCA – Goal and Scope and Inventory Analysis**	This standard describes specifically the goal and inventory analysis of the study
ISO 14042	**Environmental management – LCA – Life Cycle Impact Assessment**	This standard deals with the intricacies of the life cycle impact assessment procedure
ISO 14043	**Environmental management – LCA – Life Cycle Interpretation**	This standard deals with the issues related to life cycle interpretation procedure
ISO 14049	**Environmental management - Life cycle Assessment**	Examples of applications

Canadian Standards

- *Life Cycle Assessment*, Standard CAN/CSA-Z760, 1994.
- *Life Cycle Review* (supporting CAN/CSA-Z760), 1994.
- *Design for Environment*, Standard CAN/CSA-Z762, 1995.

Tools for LCA

Need:

- Reduce cost and complexity
- Enable review, replication

Published studies

e.g., Tellus Institute studies on packaging materials, APME EcoProfiles for plastics, etc.

Software and databases

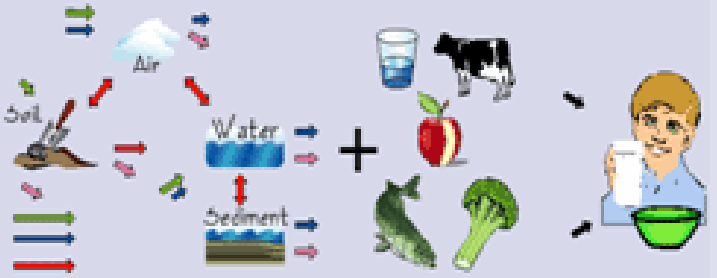
LCA Software and Databases

- Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI)
  - EPA software
  - http://www.epa.gov/nrmrl/std/sab/traci/
  - Performs impact assessment starting with LCI (inventory) data supplied by user

Inventory of Stressors
Land Use
Chemical Emissions
Water Use
Fossil Fuel Use

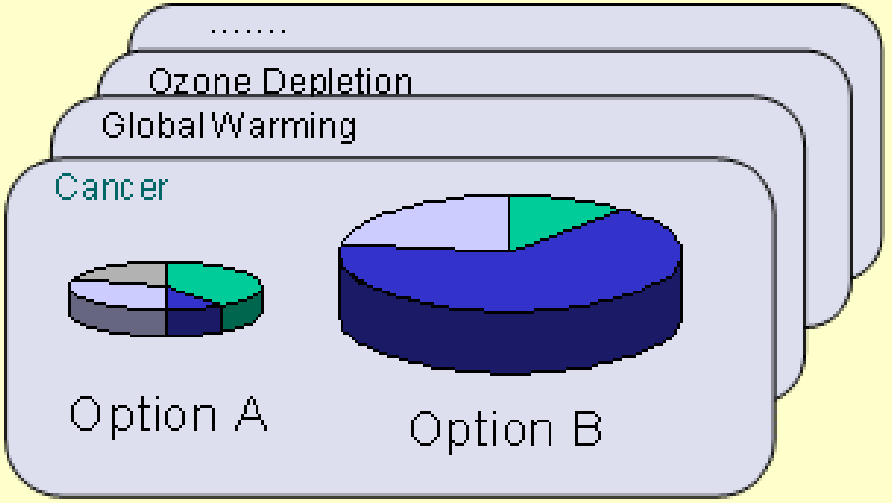
Impact Categories
Ozone Depletion
Global Warming
Acidification
Cancer
Noncancer
Criteria
Eutrophication
Smog Formation
Ecotoxicity
Fossil Fuel Use
Land Use
Water Use

Characterization (e.g., Cancer)



TRACI

Tool for the Reduction and Assessment Of Chemical and Other Environmental Impacts



Many others – here are just a few

- SimaPro
  - http://www.pre.nl/simapro/default.htm
- Boustead model
  - http://www.boustead-consulting.co.uk/products.htm
- CMLCA
  - http://www.leidenuniv.nl/interfac/cml/ssp/software/cmlca/index.html
- Ecoinvent Center
  - http://www.ecoinvent.com/

EPA's listing of LCA Resources

- http://www.epa.gov/ORD/NRMRL/lcaccess/resources.html
  - Publications
  - Web sites
  - Case studies
    - Etc.

What does this mean to the consumer?

- LCA is still the right philosophical approach for manufacturers/designers to use in making choices
  - Not all choices require full-blown LCA
- LCA needs to be interpreted, in context, to be meaningful
- We can’t realistically put LCA results on a package

Role of LCA in consumer decisions

- Can be used by certifying organizations to verify claims
- Published “generic” LCAs can be used to guide choices

Always remember – package functionality comes first. An “environmentally sound” package that delivers a broken or spoiled product, or a package that no one will buy, results in both product and package waste.